

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 0 878 263 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
07.08.2002 Bulletin 2002/32

(51) Int Cl.7: **B23K 9/095**

(21) Application number: **98303638.5**

(22) Date of filing: **08.05.1998**

(54) **Welding machine**

Schweissvorrichtung

Dispositif pour souder

(84) Designated Contracting States:
DE GB IT

(30) Priority: **16.05.1997 US 857355**

(43) Date of publication of application:
18.11.1998 Bulletin 1998/47

(73) Proprietor: **ILLINOIS TOOL WORKS INC.**
Glenview, Illinois 60025 (US)

(72) Inventors:
• **Lanouette, Andre**
Appleton, WI 54911 (US)

• **Blank, Leon**
Appleton, WI 54914 (US)
• **Herwig, Warren**
Oshkosh, WI 54901 (US)

(74) Representative: **Rackham, Stephen Neil et al**
GILL JENNINGS & EVERY,
Broadgate House,
7 Eldon Street
London EC2M 7LH (GB)

(56) References cited:
EP-A- 0 463 489 **US-A- 5 553 810**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 878 263 B1

Description

[0001] Metal-inert-gas (MIG) welding is one well known type of welding process. There are a number of different types of power supplies used for MIG welding. Examples of MIG power supplies include phase controlled, pulse width modulated and inverter power supplies. MIG welding is performed using a variety of wire diameters, wire material, and gasses. The wire and gas used depends on the plate or workpiece thickness and material. Wire diameter, wire material, gas and plate thickness are referred to herein as welding conditions.

[0002] Most MIG welding machines use at least three parameters to control the welding process. These parameters are: wire feed speed and/or current, voltage and inductance. Some MIG welding machines also have an inductance control that affects the response of the power source or supply. Typically, a MIG welding machine will have switches and/or knobs on the front panel to select some or all of the operating parameters. The process of setting one or more of these parameters is called herein machine set up.

[0003] Some prior art welding machines (as used herein welding machine refers to the power source, controller, wire feeder, and may include a gas source and other ancillary equipment used to effectuate a weld) are capable of controlling the welding arc to optimize the weld. However, proper control requires optimal operating parameters (current and/or wire feed speed and voltage) for the particular welding conditions (wire diameter, wire material and gas mixture used, as well as the plate thickness and joint type that is being welded). Prior art welding machines require the operator to calculate set-up parameters (i.e., voltage, current and/or wire feed speed) from tables or equations using the above welding conditions inputs as independent variables. Alternatively, the appropriate settings may be chosen based on past experience, or by trial and error.

[0004] If the operator provides erroneous data, or doesn't properly calculate the setup parameters, the result may be poor quality welds or inefficient use of the welding machine or consumables (gas and wire). Thus, the weld quality is dependent upon the operator properly determining setup parameters. It is not unusual for the operators to improperly select the setup parameters and have such poor quality welds that a service call is required.

[0005] US-A-5553810 discloses a welding machine provided with a bar code scanner for reading the bar code on the cover of a welding wire reel. The bar code identifies the type and size of wire within the reel.

[0006] EP-A-0463489 discloses a welding machine wherein ancillary units (such as torch height adjustment devices, a wire feed device, gas regulators, drives and sensors) are connected to one another by leads which form a local area network in order to simplify signal processing.

[0007] EP-A-0584006 discloses a welding unit includ-

ing a gas sensor wherein a controller detects the type of gas being supplied and determines whether to allow welding to commence based on the type of gas.

[0008] According to this invention a welding machine includes a welding power source;

a wire feeder coupled to the power source;
a source of gas;
a gas sensor or bar code reader to identify the gas;
and
a set up circuit coupled to the gas sensor or bar code reader, the source of gas, the power source and the wire feeder,

characterised in that a workpiece thickness sensor is also coupled to the set up circuit and in that the set up circuit automatically sets up the welding machine in response to the gas sensor or bar code reader and the workpiece thickness sensor.

[0009] Thus a welding machine automatically senses one or more of the conditions which enter into the decision for setting wire feed speed and/or current and voltage.

[0010] A wire sensor or bar code reader and/or a workpiece thickness sensor may also be provided wherein the set up circuit further automatically sets up the welding machine in response to the additional sensors.

[0011] Preferably, the wire sensor or bar code reader identifies the diameter and/or material type of the wire. The wire sensor or bar code reader may also include a scanner or an analog proximity detector, or a plurality of proximity detectors, or a displacement sensor.

[0012] The gas sensor or bar code reader may include a cyclic voltametry gas microsensor or a plurality of gas connections. The workpiece thickness detector may include a strain gauge or displacement sensor.

[0013] Particular embodiments in accordance with this invention will now be described with reference to the accompanying drawings; in which:-

Figure 1 is a block diagram of a welding machine according to one embodiment of the present invention;

Figure 2 is a drawing of a welding equipment, including a separate power source and wire feeder according to one embodiment of the present invention; and

Figure 3 is a sketch of a spool of wire welding wire and a de-reeling wire stand.

[0014] While the present invention will be illustrated with reference to a welding machine having a separate wire feeder and power source, it should be understood at the outset that the inventive welding machine with automatic parameter selection may also be implemented with other types of welding machines, including those that have the wire feeder and power source integrated

into a single housing. Also, the invention is not limited to the particular types of sensors discussed below.

[0015] Referring now to Figure 1, a welding machine 100 includes a controller 102, a power source 104, a wire feeder 106 and a gas source 108. Also shown is a welding torch 110 and a workpiece 112. Lines connecting the various boxes in Figure 1 represent connections such as power connections, feedback connections, control connections and gas connections.

[0016] Power source 104 provides weld power to wire feeder 106. Also, gas source 108 provides gas to wire feeder 106. A weld-power cable 111 connects wire feeder 106 to torch 110. The weld wire from wire feeder 106 is coaxially fed within weld power cable 111. Weld power cable 111 also includes a conduit to provide gas for torch 110. The other power supply cable provides weld power directly to workpiece 112. This cable completes the power circuit. The components described in this paragraph may be found in the prior art. The invention is not limited to this arrangement, it encompasses other welding machines as well, such as, for example, a welding machine wherein both weld power cables are run through the wire feeder.

[0017] Controller 102 provides control signals to power source 104 to control the output current and/or output voltage. Controller 102 also provides a control signal to wire feeder 106 to control the speed at which wire is fed from wire feeder 106 to torch 110. Controller 102 receives feedback signals indicative of the output voltage and current, and the wire feed speed. The feedback for the output current and voltage may be obtained from power source 104 and/or from workpiece 112 in a conventional manner. A set-up circuit contained within controller 102 uses these feedback signals to provide the desired output parameters. The set up circuit may be digital or analog, and either part of or distinct from controller 102.

[0018] Controller 102 also receives a signal from wire sensor 105 that indicates the wire diameter and the material comprising the wire. Wire sensor 105 is capable of sensing flux core and solid wires. A plate thickness signal from plate sensor 107 is provided to controller 102. Other alternatives omit one or both of the wire and gas sensors (discussed below).

[0019] A signal indicating the type of gas being provided by gas source 108 is provided by gas sensor 109 to controller 102 and the set up circuit. The particular configuration of the sensors 105, 107 and 109 will be described in detail below. However the invention is not limited to the sensors described herein.

[0020] The set up circuit and controller 102 cooperate with sensors 105, 107 and 109 to eliminate the need for the operator to select operating parameters. More specifically, prior to the initiation of the welding process wire sensor 105 detects the wire diameter and the material of the wire. This information is provided to controller 102 and the set up circuit. Also, gas sensor 109 detects the type of gas being provided by gas source 108. This in-

formation is provided to controller 102 and the set up circuit. Finally, plate sensor 107 detects the thickness of workpiece (or plate) 112 and likewise provides plate thickness data to controller 102.

[0021] These data indicative of the welding conditions are used by controller 102 and the set up circuit to determine the proper operating parameters. The set up circuit may include a microprocessor that has a lookup table from which the proper operating parameters are obtained given a set of welding conditions. Another embodiment provides for the set up circuit to include circuitry (either digital or analog) that implements equations from which the proper operating parameters are calculated. Controller 102 and the set up circuit automatically set up the machine and obviates the need for the user to determine the welding conditions and then select the proper operating parameters. Using the invention thus allows the control panel to have a single on/off switch, without the need for current, voltage or wire feed settings. Thus, the likelihood of operator error has been greatly diminished because the operator does not need to set up the machine.

[0022] An alternative embodiment uses the sensors described herein and then prompts the user to set up the machine, after indicating to the user what has been detected. This alternative would beneficially allow the user to compensate for welding conditions such as dirty plate surfaces.

[0023] Referring now to Figure 2, a sketch of welding equipment 200 configured in accordance with the preferred embodiment is shown. Welding equipment 200 includes a power source 204, a wire feeder 206 and a gas source 208. A controller (such as controller 102) and the set up circuit are located within wire feeder 206. Weld power is provided by power source 204 to wire feeder 206 on weld power cable 201. Another weld power cable 203 is connected to a plate 212. A coaxial welding cable (conduit) 211 connects wire feeder 206 to a torch 210. Thus, the weld power circuit is completed when an arc is struck between torch 210 and plate 212. A gas cylinder 208 provides gas (such as argon, carbon dioxide, helium, etc) to wire feeder 206 through a gas hose 214. Feedback (the voltage of the plate relative to the weld cable 201) is provided from plate 212 to wire feeder 206 on feedback wire 215. The plate thickness may be determined using wire 215 (as will be described below). A pair of control leads 216 and 217 are used to provide control signals from wire feeder 206 to power source 204. A current feedback signal may be provided from power source 204 to wire feeder 206 on either of wires 216 and 217.

[0024] Weld wire feeder 206 includes a hub 220 on which a reel of welding wire is mounted when the welding machine is used. The weld wire is fed from the reel through cable (conduit) 211 to torch 210, where it is used in the welding process. A bar code reader window 222 is shown on hub 220. Bar code reader window 222 is used, in one embodiment, to determine the wire diam-

eter and material. The wire reel includes, on its inside surface, a bar code which uniquely identifies the wire material and the wire diameter.

[0025] A cyclic voltametry gas sensor is disposed within (or outside if desired) wire feeder 206. The cyclic voltametry gas sensor is used to determine the gas type.

[0026] Welding equipment 200 includes a single on off switch 225 on the front panel of power source 204 (or it may be on wire feed 206). When this switch is turned on, the controller within wire feeder 206 determines the welding conditions (wire material, wire size or diameter, gas type, and plate thickness). When the operating parameters are determined as previously described, and the machine is automatically set up. One alternative provides that the set up parameters are remembered until the reel is changed (as sensed by a switch), or the set up parameters are determined (and stored) only upon power up or before power up.

[0027] One alternative embodiment uses a single knob (in addition to the on/off switch) on the front panel of power source 204 (or wire feeder 206). The knob is used to set plate thickness. The controller uses that information, rather than sensed information via feedback wire 215, to calculate the appropriate operating parameters. Alternatively, the single knob can set or trim the "heat" (actually voltage), which depends on or is a function of plate thickness.

[0028] It should be understood that neither the specific arrangements of the welding machines described above, nor the specific sensors that will be described below, limit this invention. Rather, the invention includes using sensors (or otherwise determining) one or more welding conditions so that one or more operating parameters may be automatically determined and set. With that in mind, several sensors will be described below.

[0029] The preferred embodiment uses a bar code, such as a UPC (Universal Product Code) bar code, on the reel of wire being fed into the machine. A scanner, such as a laser scanner, an LED scanner, or other bar code reader, is used to read the code and help setup the machine. Referring now to Figure 3, a spool of wire and wires stand demonstrate an embodiment using a bar code reader. A support or stand 301 is mounted on wire feeder 206. Stand 301 supports hub 220. Hub 220 has window 222 thereon, through which a bar code reader scans. A spool of weld wire 305 is placed on hub 220. A bar code is placed on an inner surface 307 of reel 305. When the spool of wire 305 is placed on the hub 220 (which spins with the reel) the bar code is aligned with window 222 so that the controller can determine the type of wire and the diameter of the wire.

[0030] Alternatively, the controller can determine the wire type and diameter as the reel is rotated to feed the wire to the arc during set-up when the wire is jogged through the conduit 211. Another alternative is to provide the bar code on the side of wire spool 305 and the bar code reader on support 301. Again, a slot should be

provided in reel 306 through which the bar code can be read. Another embodiment includes a bar code wand connected to the controller. When the wand is used to read the bar code. This alternative is particularly useful when pay-out-packs (where the wire is pulled from the center of the coil) are used. Another alternative is provide a series or set of indentations, bumps, or other mechanical markings or irregularities on the wire reel or drive rolls which could be read by mechanical fingers, switches, or optical switches. Generally, these sensors "read" an indicator of the wire material and diameter that is provided on the wire. Another embodiment uses a tab or card provided with the wire roll, that may be inserted into a reader. It should be recognized there are many variations to this type of sensor.

[0031] If other types of wire sensors are used, a separate wire material sensor and a wire diameter sensor may be provided. One commercially available material sensor is an analog proximity detector (one such detector is presently available from Gordon Industries). Alternatively, an analog proximity detector may be constructed using an analog oscillator. A reference coil can be switched into the oscillator circuit to determine the free-running frequency of the oscillator (i.e. frequency with no wire present). This can be used to eliminate external environmental effects (temperature, humidity, extraneous magnetic materials, etc.) on circuit operation.

[0032] One design uses a coil, wherein the welding wire forms the core of a solenoidal inductor. Care should be taken to avoid chafing the welding wire and the coil. Other geometries, such as an "C" core with the wire passing in front of the legs of the "C" to complete the magnetic circuit, may avoid the chafing problem.

[0033] Another embodiment for detecting wire material uses multiple proximity switches. Each proximity switch is tuned to detect a specific material. Therefore, three switches (tuned for mild steel, aluminum, and stainless steel) could detect the three material types of interest. Additional switches could be provided for other material (or flux core wire).

[0034] Another wire material sensor includes a Hall Effect sensor placed on the opposite side of the wire being sensed from an oscillating magnetic field source. The wire interferes with the magnetic field as it does in the analog oscillator. The Hall Effect sensor measures the magnetic field, and material type is determined based upon the measured field. Also, a reference Hall Effect sensor may be used to provide the same environmental immunity as described above for analog proximity sensor.

[0035] A circuit (electric or magnetic e.g.) whose operation is affected by the presence of welding wires of different compositions such that key parameters of circuit operation (voltage, current, frequency, charge, etc.) vary in a manner which allows the different wire compositions to be determined could also be used to determine wire material. Alternatively, a source of radiation (magnetic, electric, or heat) and a sensor could be used to

determine how the welding wire affects the radiation field and thereby determine wire material and/or diameter.

[0036] One alternative embodiment of the wire diameter sensor is to use a displacement sensor which interrupts a light beam in an amount dependent on the wire diameter. A light beam and sensor are provided near a wire inlet guide. A cam follower is also provided near the wire inlet guide. The cam follower displaces a nonreflective probe into the path of the light beam, thereby reducing the light flux of the beam. The reduction in light flux is proportional to the diameter of the wire. Suitable light detectors include photocells, photo-resistors, photo-transistors, light-intensity-to-voltage converters, light-intensity-to-current converters, light-intensity-to-frequency converters, or other light sensitive electronic devices.

[0037] Alternatively, the wire itself may be used to interrupt the light beam. However, care should be taken to avoid the accumulation of dirt and moisture on the light emitter and sensor. Other sensors for measuring the movement of the cam follower include a strain gauge attached to the cam follower, a linear potentiometer, or a piezoelectric sensor. Each of these sensors use the wire to mechanically displace something and measure the displacement.

[0038] Another device for measuring wire diameter uses a variable frequency analog oscillator to sense the wire at various frequencies. The skin depth of the signal equals the diameter of the wire at some frequency. When this frequency is reached, the effect of the wire on the oscillator does not change with further changes in frequency. This frequency is determined by scanning or varying frequencies, and from this frequency the diameter of the wire is determined.

[0039] Another diameter sensor is a capacitive sensor, which is available commercially (from Gordon Industries e.g.). Generally, any diameter sensor will suffice to implement the present invention, although the type described above may be practical given current technology.

[0040] One preferred embodiment of the gas sensor includes different gas connections on the wire feeder for different welding gases. The connectors would be a different size or shape so that they could not be interchanged. The gas hoses then have mating connectors. For example, argon, CO₂, and mixed gas hoses would each have a unique connector which would connect to similar mating connectors on power source 206 or wire feeder 204. A pressure sensor (such as a transducer) or flow detector in each gas line internal to the welding machine determines which gas is being used for welding. This embodiment may be used to detect the lack of any gas being used. A variation of this embodiment uses lockout gas valves to prevent gas flow in the lines not being used. When a gas line is connected the pressure on the line being used forces a valve closed on the other lines. A limit switch is then used to detect which valves

are closed and therefore determine the gas being used.

[0041] Another preferred embodiment relies on a cyclic voltammetry gas microsensor. Such a sensor is described in "An Intelligent Gas Microsensor with Neural Network Technology", SENSORS, October 1996. This sensor uses cyclic voltammetry and a computational neural network to determine gas type. A cyclic voltage is applied to an electrolyte material sandwiched between two electrodes. The gas to be determined interacts with the surface of the electrolyte and the current passing through the device is altered at characteristic voltages for each gas. A plot of current versus voltage indicates the gas type.

[0042] One other gas sensor used to implement the invention relies on differences in intrinsic gas properties of argon, CO₂, O₂, and helium. The intrinsic properties include heat capacity or specific heat at constant pressure, C_p , heat capacity at constant volume, C_v , the ratio of heat capacities, C_p/C_v , thermal conductivity, k and density, p . The properties are measured using an insulated plastic housing that contains a heater (a 2 W resistor) and a negative temperature coefficient resistor (NTCR or thermistor). The gas being used fills the box (through a closable vent) and power is applied to the resistor. The temperature of the gas is measured with the NTCR as the gas warms up. Each gas warms up at a unique rate dependent on the heat capacity, thermal conductivity, and density of the gas. The value for $K/C_v P$, in ($m^3 K/KJ$), is 0.3032 for helium, 0.0345 for argon, 0.0301 for oxygen, 0.0298 for air and 0.0130 for carbon dioxide. $K/C_v P$ is measured for the gas being used, and compared to the known values, and a determination is made as to which gas is present.

[0043] Another gas sensor that may be used measures the thermal conductivity of a gas. It consists of a thin insulated tube with a heater (resistor) disposed one end, a heat sink at the other, and two NTCR's placed some distance apart in between. The gas is admitted into the tube and the heater activated. The heat causes a temperature gradient in the gas that is measured. Gases with a higher heat conductivity will have less of a temperature gradient. Thus, by comparing the measured gradient to known gradients, the gas that is present may be determined. The tube should be insulated to prevent heat loss, and the known gradients may be determined empirically by measuring the gradient for various types of welding gas.

[0044] Other sensors can use LEDs tuned to frequencies which are absorbed in different amounts by the gases typically used for welding. For example, CO₂ is opaque at infrared wavelengths. Thus, the frequencies (or wavelengths) used are selected so that each gas may be identified. When the type of gas may be determined from the relative absorption spectra. Commercially available sensors which determine the type of gas include depleting or nondepleting sensors. Another commercially available sensor is an automotive oxygen sensor (used for pollution control systems).

[0045] The gas sensors used herein could be active during a "pre-flow" or purge period wherein gas is flowing before the welding process is initiated

Also, a bar code reader could be used to determine the gas type. The scanner could be mounted on the cart that holds the gas cylinder, or a wand may be provided. When the wire sensor is also a bar code reader, a single wand can be provided. Each bar code may then be read, and the controller can determine which welding condition is being sensed, as well as what the condition is. Alternatively, a mechanical sensor like those described with reference to the wire sensor, such as those using bumps or a card or tab, may be used.

[0046] The preferred embodiment of the plate thickness detector is placing the ground clamp 227 with a strain gauge or potentiometer on the workpiece to determine how wide the clamp is opened, and thereby measure thickness. Thus, by merely clamping the ground clamp so that each side of the plate is touched, the thickness may be measured. At some thickness the maximum output of the machine is reached. Further increases in thickness cannot be compensated for by changing the setup parameters. Accordingly, the size of the clamp should be sufficient to measure this thickness. When the maximum is reached, the user may be warned via a display, light or alarm. Another embodiment uses a variable frequency analog oscillator. The thickness of the workpiece is determined from the frequency where skin depth equals a predetermined fraction of the workpiece thickness. Skin depth is determined over a range of (or several discrete) frequencies. When the frequency and corresponding skin depth is compared by the controller to previously empirically determined values.

[0047] It should be clear from the description of the preferred embodiment that a wide variety of sensors may be used to implement the inventive welding machine that has automatic set-up.

Claims

1. A welding machine (105) including a welding power source (104);

a wire feeder (106) coupled to the power source (104);

a source of gas (108);

a gas sensor or bar code reader (109) to identify the gas; and

a set up circuit (102) coupled to the gas sensor or bar code reader (109), the source of gas, the power source and the wire feeder (106),

characterised in that a workpiece thickness sensor (107) is also coupled to the set up circuit (102) and in that the set up circuit (102) automatically sets up the welding machine in response to the gas sensor or bar code reader (109) and the

workpiece thickness sensor (107).

2. A welding machine (105) according to claim 1, wherein a wire sensor or bar code reader to identify the diameter and/or material type of the wire is also coupled to the set up circuit (102) which further automatically sets up the welding machine in response to the wire sensor.
3. A welding machine (105) according to claim 2, wherein the wire sensor or bar code reader includes a scanner or an analog proximity detector or a plurality of proximity detectors or a displacement sensor.
4. A welding machine (105) according to any one of the preceding claims, wherein the gas sensor or bar code reader (109) includes a cyclic voltametry gas microsensor, or a scanner or a plurality of gas connections.
5. A welding machine (105) according to any one of the preceding claims, wherein the workpiece thickness sensor (107) includes a strain gauge.
6. A welding machine (105) according to any one of the preceding claims, wherein the welding power source (104) provides welding power;
 - wherein the wire feeder (106) is coupled to receive welding power from the welding power source (104),
 - wherein the wire feeder (106) supplies wire and weld power to a welding cable (111);
 - wherein a wire diameter sensor is disposed to sense the diameter of the wire, and to provide a diameter signal indicative of the wire diameter; and
 - wherein a wire material sensor is disposed to sense the material comprising the wire, and to provide a material signal indicative of the wire material.
7. A welding machine (105) according to claim 6, wherein the gas sensor or bar code reader (109) provides a gas signal indicative of the type of gas, and wherein the set up circuit (102) further includes a gas type input and wherein the wire feed speed, current, and voltage outputs are further responsive to the gas type input, and wherein the gas type input is coupled to the gas type sensor or bar code reader (109).
8. A welding machine (105) according to claim 6 or claim 7, wherein the workpiece thickness sensor (107) provides a thickness signal indicative of the thickness of the workpiece, and wherein the set up circuit (102) further includes a thickness input and wherein the wire speed feed, current, and voltage outputs are further responsive to the thickness input, and wherein the thickness input is coupled to

workpiece thickness sensor (107).

Patentansprüche

1. Schweißvorrichtung (105) mit einer Schweißstromquelle (104);

einer mit der Stromquelle (104) verbundenen Drahtzuführvorrichtung (106)
einer Gasquelle (108)
einem Gassensor oder Strichkodelesegerät (108) zum Erkennen des Gases; und
einem mit dem Gassensor oder dem Strichkodelesegerät (109), der Gasquelle, der Stromquelle und der Drahtzuführvorrichtung (106) verbundenen Einstellkreis (102),

dadurch gekennzeichnet, daß ein Werkstückdickensensor (107) ebenfalls mit dem Einstellkreis (102) verbunden ist, und daß der Einstellkreis (102) die Schweißvorrichtung entsprechend dem Gassensor oder dem Strichkodelesegerät (109) und dem Werkstückdickensensor (107) automatisch einstellt.

2. Schweißvorrichtung (105) nach Anspruch 1, wobei ein Drahtsensor oder Strichkodelesegerät (108) zum Erkennen des Durchmessers und/oder der Art des Materials des Drahtes ebenfalls mit dem Einstellkreis (102) verbunden ist, der ferner die Schweißvorrichtung entsprechend dem Drahtsensor automatisch einstellt.

3. Schweißvorrichtung (105) nach Anspruch 2, wobei der Drahtsensor oder das Strichkodelesegerät einen Scanner oder einen Analog-Annäherungsdetektor oder mehrere Annäherungsdetektoren oder einen Verschiebungssensor umfaßt.

4. Schweißvorrichtung (105) nach einem der vorhergehenden Ansprüche, wobei der Gassensor oder das Strichkodelesegerät (109) einen zyklisch die Spannung messenden Gas-Mikrosensor oder einen Scanner oder mehrere Gasanschlüsse umfaßt.

5. Schweißvorrichtung (105) nach einem der vorhergehenden Ansprüche, wobei der Werkstückdickensensor (107) eine Dehnungsmeßvorrichtung umfaßt.

6. Schweißvorrichtung (105) nach einem der vorhergehenden Ansprüche, wobei die Schweißstromquelle (104) einen Schweißstrom bereitstellt;

wobei die Drahtzuführvorrichtung (106) so angeschlossen ist, daß sie Schweißstrom aus der Schweißstromquelle (104) aufnimmt,

wobei die Drahtzuführvorrichtung (106) Draht

und Schweißstrom zu einem Schweißkabel (111) liefert;

wobei ein Drahtdurchmessersensor angeordnet ist, um den Durchmesser des Drahtes abzufühlen und ein den Drahtdurchmesser anzeigendes Durchmesser-Signal abzusetzen; und

wobei ein Drahtmaterialsensoren angeordnet ist, um das den Draht umfassende Material abzufühlen und ein das Drahtmaterial anzeigendes Material-Signal abzusetzen.

7. Schweißvorrichtung (105) nach Anspruch 6, wobei der Gassensor oder das Strichkodelesegerät (109) ein die Gasart anzeigendes Signal absetzt, und wobei der Einstellkreis (102) ferner einen Eingang für die Gasart umfaßt, und wobei die Ausgänge für die Drahtzuführgeschwindigkeit, den Strom und die Spannung ferner auf den Eingang für die Gasart ansprechen, und wobei der Eingang für die Gasart mit dem Sensor für die Gasart oder dem Strichkodelesegerät (109) verbunden ist.

8. Schweißvorrichtung (105) nach Anspruch 6 oder Anspruch 7, wobei der Werkstückdickensensor (107) ein die Dicke des Werkstücks anzeigendes DickenSignal absetzt, und wobei der Einstellkreis (102) ferner einen Eingang für die Dicke umfaßt, und wobei die Ausgänge für die Drahtzuführgeschwindigkeit, den Strom und die Spannung ferner auf den Eingang für die Dicke ansprechen, und wobei der Eingang für die Dicke mit dem Werkstückdickensensor verbunden ist.

Revendications

1. Machine de soudage (105) comprenant une source (104) d'énergie de soudage;

un dispositif (106) d'avancement de fil couplé à la source d'énergie (104);

une source de gaz (108);

un capteur de gaz ou lecteur (109) de code à barres pour identifier le gaz, et

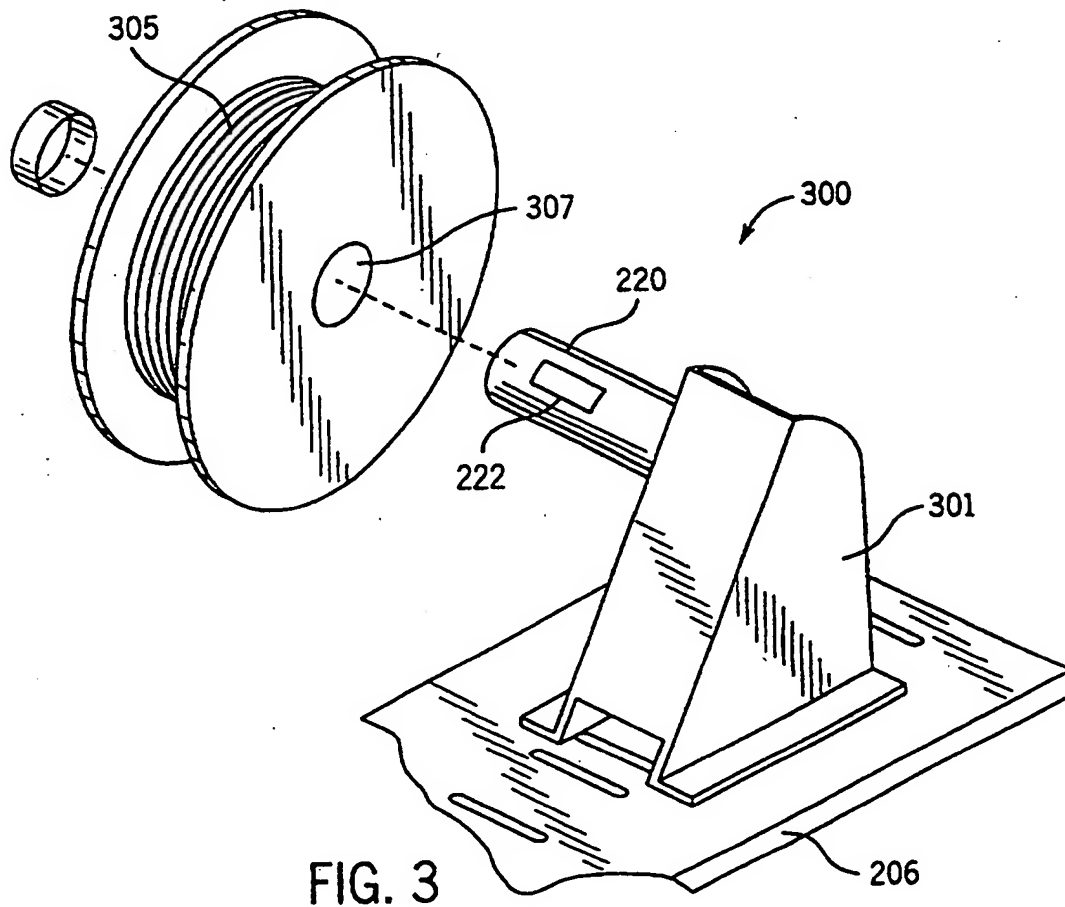
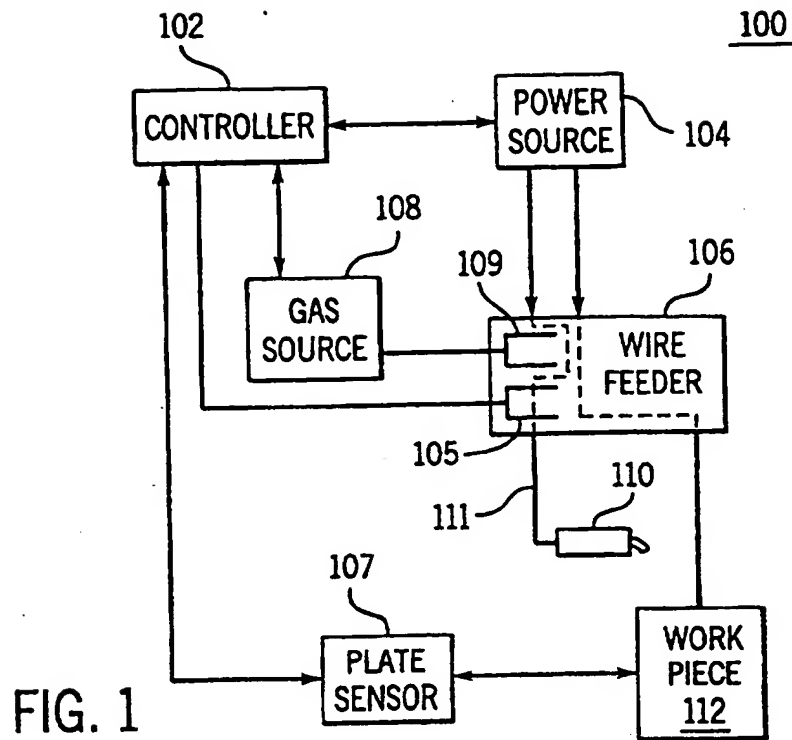
un circuit de réglage (102) couplé au capteur de gaz ou au lecteur (109) de code à barres, à la source de gaz, à la source d'énergie et au dispositif (106) d'avancement de fil;

caractérisée en ce qu'un capteur (107) d'épaisseur de pièce est également couplé au circuit de réglage (102), et **en ce que** le circuit de réglage (102) règle automatiquement la machine de soudage en réponse au capteur de gaz ou lecteur (109) de code à barres et au capteur (107) d'épaisseur de pièce.

2. Machine de soudage (105) selon la revendication

- 1, dans laquelle un capteur de fil ou lecteur de code à barres servant à identifier le diamètre et/ou le type de matériau du fil, est également couplé au circuit de réglage (102), qui règle en outre automatiquement la machine de soudage en réponse au capteur de fil. 5
3. Machine de soudage (105) selon la revendication 2, dans laquelle le capteur de fil ou lecteur de code à barres comprend un scanner, un détecteur de proximité analogique, une pluralité de détecteurs de proximité ou un capteur de déplacement. 10
4. Machine de soudage (105) selon l'une quelconque des revendications précédentes, dans laquelle le capteur de gaz ou lecteur (109) de code à barres comprend un microcapteur de gaz par voltamétrie cyclique; un scanner ou une pluralité de connexions de gaz. 15
20
5. Machine de soudage (105) selon l'une quelconque des revendications précédentes, dans laquelle le capteur (107) d'épaisseur de pièce comprend une jauge de contrainte. 25
6. Machine de soudage (105) selon l'une quelconque des revendications précédentes, dans laquelle la source (104) d'énergie de soudage délivre une énergie de soudage; 30
dans laquelle le dispositif (106) d'avancement de fil est couplé pour recevoir de l'énergie de soudage de la source (104) d'énergie de soudage;
dans laquelle le dispositif (106) d'avancement de fil délivre du fil et de l'énergie de soudage à un câble de soudage (111); 35
dans laquelle un capteur de diamètre de fil est disposé pour détecter le diamètre du fil et pour délivrer un signal de diamètre indicatif du diamètre du fil; et
dans laquelle un capteur de matériau de fil est disposé pour détecter le matériau constituant le fil et pour délivrer un signal de matériau indicatif du matériau du fil. 40
7. Machine de soudage (105) selon la revendication 6, dans laquelle le capteur de gaz ou lecteur (109) de code à barres délivre un signal de gaz indicatif du type du gaz, et dans laquelle le circuit de réglage (102) comprend en outre une donnée d'entrée de type de gaz, et dans laquelle les sorties de vitesse d'avancement du fil, de courant et de tension répondent en outre à la donnée d'entrée de type de gaz, et dans laquelle la donnée d'entrée de type de gaz est couplée au capteur de type de gaz ou au lecteur (109) de code à barres. 45
50
55
8. Machine de soudage (105) selon la revendication 6 ou la revendication 7, dans laquelle le capteur (107)

d'épaisseur de pièce délivre un signal d'épaisseur indicatif de l'épaisseur de la pièce, et dans laquelle le circuit de réglage (102) comprend en outre une donnée d'entrée d'épaisseur, et dans laquelle les sorties de vitesse d'avancement de fil, de courant et de tension répondent en outre à la donnée d'entrée d'épaisseur, et dans laquelle la donnée d'entrée d'épaisseur est couplée au capteur (107) d'épaisseur de pièce.



BEST AVAILABLE COPY

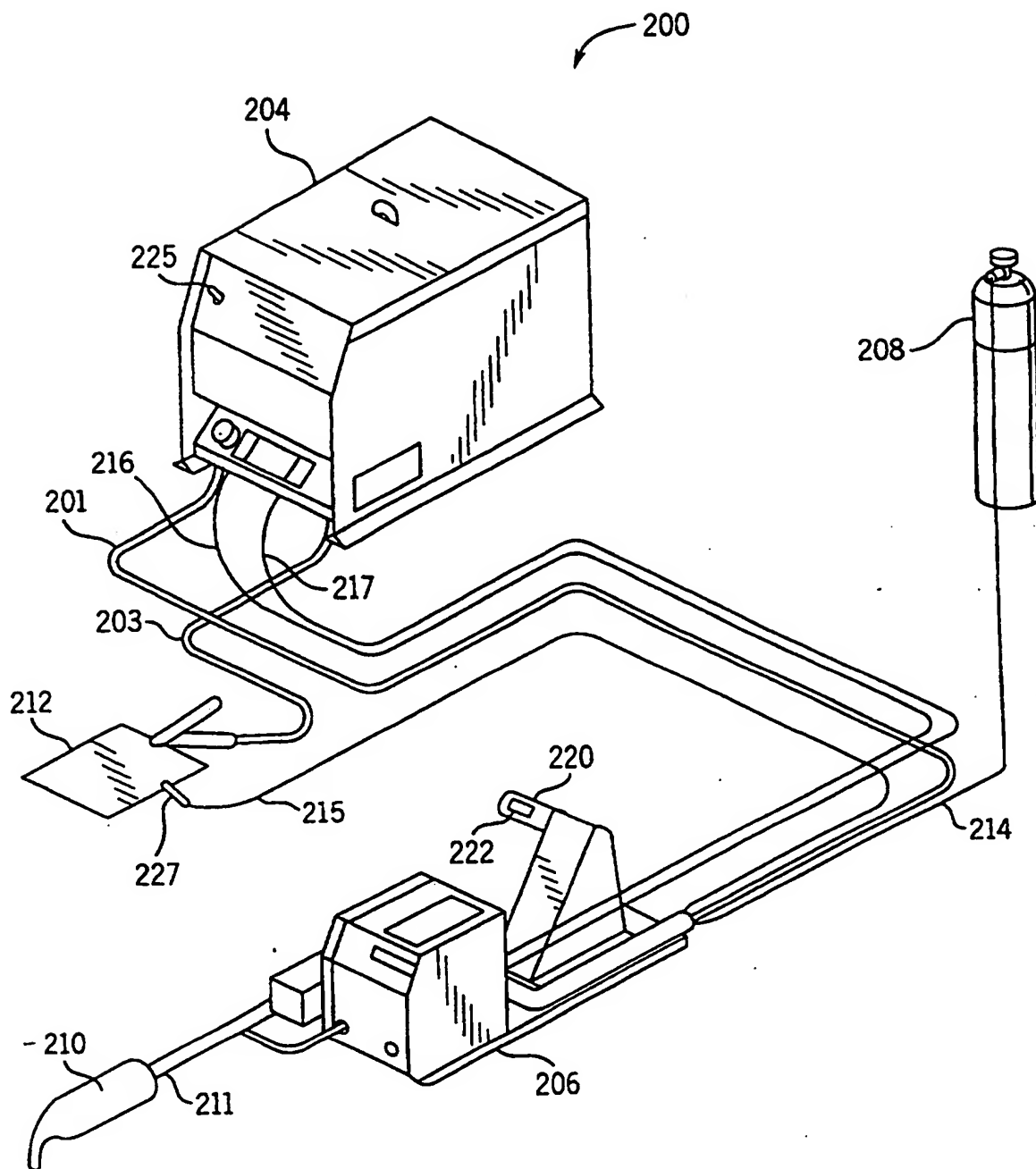


FIG. 2